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SECTION 02329 – HOPPER DREDGE SILENT INSPECTOR

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PART 1 GENERAL

1.0 INTRODUCTION

The Silent Inspector (SI) for Hopper Dredges is a system that can monitor dredge position, dredge state, compute dry tonnage, and report and manage the data for Corps of Engineers dredging contracts. This specification defines the data collection needs of the Contracting Officer for managing the present and proposed future contracts whereby the Government will measure and compensate the contractor based on performance. Most of the required data parameters are currently available through existing sensors on industry hopper dredges. The collection and recording of the data in standard format will afford timely analysis of these data for dredge performance indicators. On unit priced contracts, SI will be used to verify parameters and assist in evaluating claims.

(District optional)
It is the spirit and intent of this section of the specifications to define: a) the data collection needs for computing tons dry solids, and b) those data to be used as a pay-for-performance indicator in future hopper dredging contracts within the (District name here) District, and for other potential applications by the Corps of Engineers.

Additionally, the data will assist the CONTRACTING OFFICER or his/her representative with contract administration and lessen government manpower allocations for continuous inspection, and meet ever increasing environmental monitoring requirements established by the responsible agencies. The SI system collects and records measurements from shipboard sensors, calculates the dredging activities and the weight of the recovered material, and displays this information with standard reports and graphical displays. Recorded data are also automatically backed up, and later archived to allow transfer of the data to other locations.

The system consists of sensors connected to two primary components: a dredge-specific system component (DSS), and a ship-based component Dredge Monitoring Computer (DMC) (CONTRACTING OFFICER or his/her representative's computer). The DSS (Dredge Specific System) collects sensor data, checks these data against acceptable ranges, computes the status of the dredging pumps (on/off) and other equipment and sends the data via serial link to the Ship Server. The DMC attaches the dredge name and contract/permit number to the DSS provided data, and inserts data into the system's central database. The DMC maintains the system's central database, accepting data in near-real time from a

DSS. The DMC then reviews those data, computes the present dredging activity being performed and the amount of material recovered, and produces reports (trip, daily) and graphical displays of the data. Additional information concerning the dredging project, the dredges used, and location of the dredging and disposal areas are also inserted into the system database.

1.2 PAYMENT (TAILORED BY DISTRICT)

The system shall be operational at the start of dredging. The Contractor shall include all costs for this system within the Lump Sum price for "Hopper Dredge Silent Inspector".

If the system is not operational after 15 days after the Notice to Proceed, or if the system becomes inoperable for a period of time greater than allowed within this section, the hourly rate of pay for the dredge for 100% pay time will be reduced to 80% of the original bid price until the system is fully operational. Installation of the system shall not relieve the contractor of the requirements within the paragraph entitled "Delivery of Plant" located in the Special Contract Requirements Section.

1.3 DREDGE PLANT INSTRUMENTATION PLAN

The contractor shall develop a Dredge Plant Instrumentation Plan (DPIP) that shows how the contractor will gather sensor data, perform quality control on those data, calibrate and repair sensors/data reporting equipment when they fail, and distribute the sensor data and computed dredge specific data to the CONTRACTING OFFICER or his/her representative's computer via a standard interface. The contractor shall keep a log of sensor problems and repairs. Re-calibration may be directed by the Contracting Officer or his/her representative at any time during contract execution as deemed necessary. No recalibration or adjustments to the calibration controls shall be performed in the absence of the CONTRACTING OFFICER or his/her representative. Physical documentation of the calibration procedures and corresponding printed verification data shall be provided for every calibration event.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 SENSOR SPECIFICATIONS

The contractor shall provide, operate and maintain all hardware and software

to meet the following specifications.

3.1.1 Slurry densities of port and starboard dragarms

The slurry density of each dragarm shall be recorded by a density-metering device approved for use by the CONTRACTING OFFICER or his/her representative and calibrated according to the manufacturer's specifications prior to commencement of work and documented in the DPIP.

3.1.2 Slurry velocities of port and starboard dragarms

The slurry velocities of each dragarm should be obtained by a flow-metering device approved for use by the CONTRACTING OFFICER or his/her representative and calibrated according to the manufacturer's specifications prior to commencement of work and documented in the DPIP. A magnetic flow-metering device calibrated according to manufacturer's specifications prior to commencement of work is the preferred flow-metering device. The slurry velocity shall be obtained using the same pipeline inside diameter as the slurry density measurement.

3.1.3 Draghead depths

The depth of each draghead (relative to the water surface) shall be obtained with a minimum accuracy of $\pm$ 1/2 foot with values recorded to the nearest 1/10 foot. Conventional bubbler or other dragarm measuring systems may be used to provide both draghead depths, but their operation and accuracy must be described in detail in written form and included in the DPIP for approval prior to dredging. Draghead depth data shall be relative to the water surface level without tidal elevation adjustments.

3.1.4 Horizontal Positioning

Horizontal dredging equipment positioning shall be provided in Lambert State Plane coordinates based on North American Datum 1983. Horizontal positioning shall be obtained using differential Global Positioning System (DGPS) equipment operating with a minimum accuracy level of 1-3 meters horizontal Circular Error Probable (CEP). Differential Correction broadcasts will be furnished 24 hours/day by the Government in standard RTCM SC-104 ver 2.0 output. Horizontal positioning shall be recorded to the nearest whole foot when provided in State Plane coordinates.

3.1.5 Vessel Heading and Course

Vessel headings shall be provided using industry standard equipment described in written form and approved by the CONTRACTING OFFICER or his/her representative prior to dredging. Calibration shall be performed according to manufacturer's specifications prior to commencement of work and documented in the DPIP. The contractor shall provide dredge compass heading with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention. Furthermore, the contractor shall provide dredge course over ground with values from 000 (true north) to 359 degrees referenced to a clockwise positive direction convention.

3.1.6 Draft

Fore and Aft draft measurements shall be reported to the nearest 1/100-foot from the hopper dredge's keel. Industry standard bubbler systems or equivalent system approved by the CONTRACTING OFFICER or his/her representative prior to dredging may be used by the contractor. The contractor must provide, as part of the DPIP documentation, how to relate measured fore and aft draft values to external draft markings on the hopper dredge. The contractor shall verify draft sensor calibration according to manufacturer's specifications prior to commencement of work and document the calibration in the DPIP.

3.1.7 Hopper level

Fore and aft hopper material level measurements shall be obtained with a minimum accuracy of $\pm$ 1/10 foot with values recorded to the nearest 1/100-foot. To minimize the influence of vessel trim and list, four hopper level measurement sensors are recommended, two (port and starboard) fore and two (port and starboard) aft sensors. A minimum of two sensors are required, one fore and one aft. If only two sensors are used, they should be mounted in a location as close as possible over the hopper centerline and away from discharge flume turbulence and foam. If more than one fore or one aft sensor is used, then they should be placed near the corners of the hopper and the average value of the fore sensors and the average value of the aft sensors shall be reported. The contractor shall maintain a functional spare sensor on-board the dredge. The contractor shall install and calibrate the sensors according to manufacturer's directions and guidelines.

As part of the DPIP submittal, the contractor shall provide calibration information for all sensors. The plan shall include four measurements of different hopper levels, comparing the sensor value to a standard, i.e., a tape measure. The CONTRACTING OFFICER or his/her representative may perform checks of the reported sensor to hopper level distance. Distance from sensor face to: 1) bottom of hopper and, 2)

reference elevation for ullage measurements to calculate volume of hopper contents, shall be measured and provided to the CONTRACTING OFFICER or his/her representative as a part of the DPIP.

3.1.8 Tide

Tide data shall be obtained using appropriate equipment to give the water level accurate to the nearest 1/10 foot. Government furnished benchmark location and water level datum information will be provided at the dredging site and given to the contractor. Above datum (positive) tide values shall be entered with a positive sign, and below datum tide values shall be entered with a negative sign.

3.1.9 Hopper status

Open/closed measurements of hopper status shall be obtained. These data correspond to the split/not-split condition for a split hull hopper dredge. A hopper dredge with hopper doors may measure the status of a single door that is the first opened during normal disposal operations. A OPEN value refers to when the hopper door is open or in the case of split hull dredges, the hull is split. A CLOSED value refers to when the hopper doors are closed or in the case of split hull dredges, the hull is not split. The format is shown in paragraphs 3.4.2 and 3.4.3.

3.1.10 Material recovery

True/False reports of material recovery shall be obtained. A True value refers to when the dredge is actually digging material. The contractor shall submit as part of the DPIP the project and dredge specific criteria used to determine this state for approval by the CONTRACTING OFFICER or his/her representative. An example criterion is shown in section 3.4.3.

3.1.11 Date and time

The date and time shall be reported to the nearest second in the format shown in sections 3.4.2 and 3.4.3. The time shall be referenced to UTC time. The reported time is the time the measurements were taken.

3.1.12 Pumpout

Open/closed measurements of dredge pumpout valve status shall be obtained. This measurement shall be True when the dredge is pumping out and False when it is not. The format is shown in sections 3.4.2 and 3.4.3.

3.1.13 Pumping water

True/False reports of pumping water shall be obtained. A True value refers to when the dredge is not digging material but pumping water (or very low-density material) through the dredge pump(s). The contractor shall submit as part of the DPIP the project and dredge specific criteria used to determine this state for approval by the CONTRACTING OFFICER or his/her representative. An example is shown in section 3.4.3.

3.1.14 Minimum pumping effort

True/False reports of minimum pumping effort shall be obtained. A True value refers to when the dredge's pumps are running at idle speed or are off. The contractor shall submit as part of the DPIP the project and dredge specific criteria used to determine this state for approval by the CONTRACTING OFFICER or his/her representative. An example is shown in section 3.4.3.

3.2 PERFORMANCE REQUIREMENTS

3.2.1 Sensors

The contractor shall be responsible for replacement or repair of sensors and other necessary data acquisition equipment needed to supply the required data. Repairs must be completed within 48 hours after a sensor failure occurs or after the contractor fails to report required data within the specified time window (section 3.4.1) for dredge measurements. Pay will be reduced for failure to meet these system performance requirements.

3.2.2 System

To meet the overall goals stated in the introduction, the contractor's DSS system shall provide a minimum 95 percent data return. Data return is defined as the total number of valid data strings sent by the DSS system to the CONTRACTING OFFICER or his/her representative's computer divided by the number of data strings that are possible to send during a given time interval. The possible number of data strings for a given time interval is defined by the data-reporting interval in paragraph 3.4. Acceptable system performance includes the system consistently reporting correct data, especially at major transitions in the dredging cycle. Pay may be reduced at the discretion of the CONTRACTING OFFICER or his/her representative for failure to meet these system performance requirements.

3.3 CONTRACTOR PROVIDED EQUIPMENT

3.3.1 Data Monitoring Computer

The contractor shall supply the CONTRACTING OFFICER or his/her representative a computer that will run Corp's software and receive data from the contractor's data reporting interface. The DMC should contain at minimum a Pentium IV (or equivalent) microprocessor with no less than a 1.2 Gigahertz CPU. The computer must contain a hard disk no smaller than 8 Gigabytes, include at least 256 Megabytes of system memory, support the PCI system bus and support the Windows 2000 operating system. The contractor shall be responsible for obtaining component vendor software drivers if the drivers are not provided with the latest release of the Windows 2000 operating system software. The computer must also contain an Ethernet adapter that supports 10BaseT Unshielded Twisted Pair connections that shall connect to the network hub (contractor shall supply a stranded Category 5 UTP patch cable to the network hub and two spares). Also, it should have a standard 101 key keyboard, Microsoft compatible mouse, at minimum one parallel, two unoccupied serial ports, a universal serial bus port, and a CD-ROM drive (16X speed or faster). It should also have a minimum of 17-inch (viewable-size measured diagonally) video monitor capable of supporting at a minimum XVGA resolution of 1024x768 pixels, 65536 viewable colors. Also the system should include a 100Mb Zip disk mounted either internally or externally. The contractor shall make available all computer related owner's guides and instruction manuals.

If a CONTRACTING OFFICER or his/her representative's hardware (including printer and other hardware) fails to operate properly, the CONTRACTING OFFICER or his/her representative is responsible to determine the nature of the problem. If a hardware problem is identified, then the contractor shall be responsible for repairing it within 48 hours.

3.3.2 Network Hub

The CONTRACTING OFFICER or his/her representative's computer shall communicate via IEEE 802.3 Ethernet and the TCP/IP networking protocol. The contractor shall provide to the CONTRACTING OFFICER or his/her representative a network hub to allow the temporary addition of the CONTRACTING OFFICER or his/her representative's portable computers to the computer network. The hub should provide a minimum of four RJ-45 ports that support Category 5 Unshielded Twisted-Pair Network wiring.

3.3.3 UPS

The contractor shall also supply an Uninterruptible Power Supply (UPS) for the computer and networking equipment. The UPS should provide backup power at

1kVA for a minimum of 10 minutes. The UPS should have a serial interface to the CONTRACTING OFFICER or his/her representative's computer to communicate UPS status. The contractor shall ensure that sufficient power outlets are available to run all specified equipment.

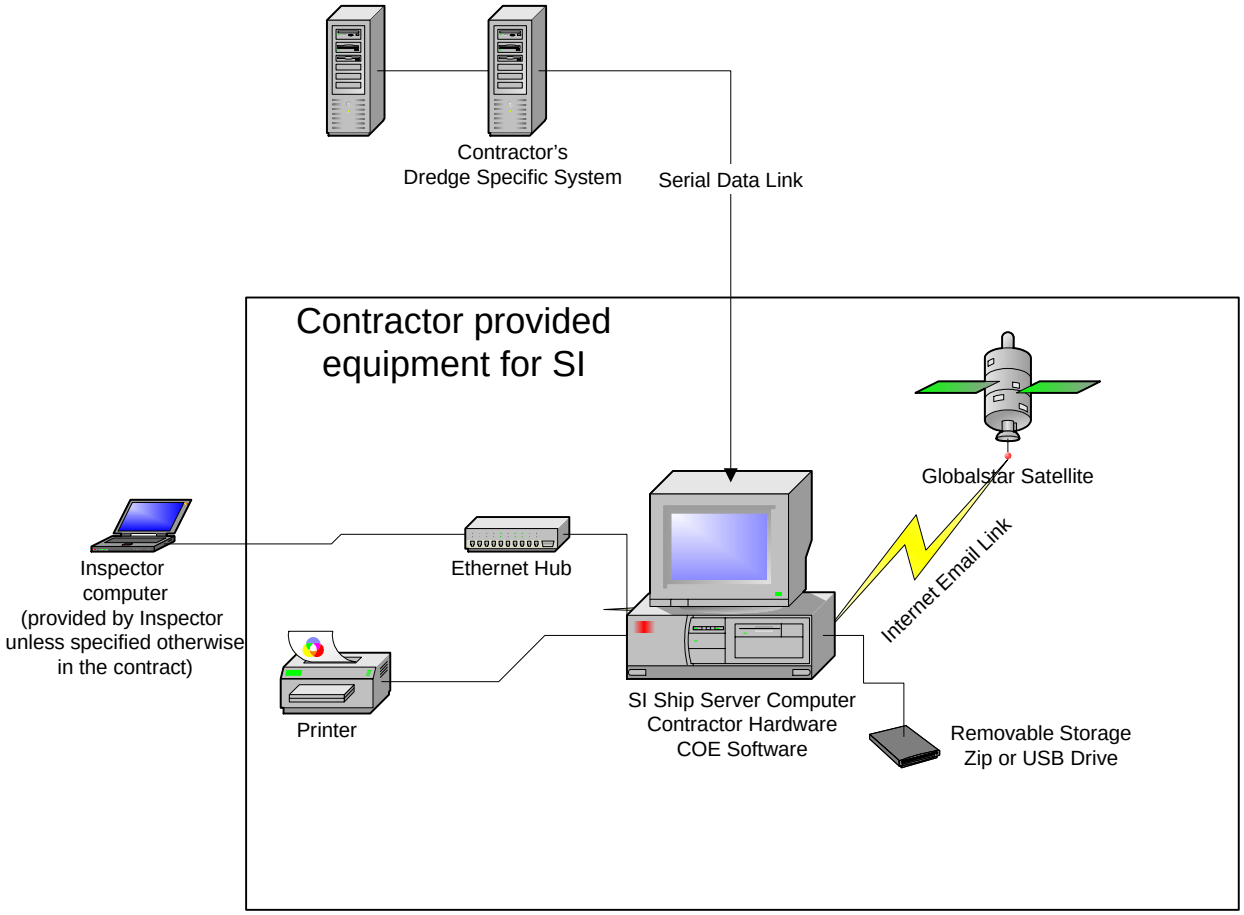
3.3.4 Printer

The contractor shall supply a printer. The printer will connect to the specified Ship computer via a parallel interface (cable supplied by the contractor). The printer should support the Adobe Postscript Level 2-page description language. Also, the printer should have a minimum resolution of 300 dots per inch and have a rated print speed of 6 pages per minute or higher. Additionally, the printer should have minimum paper capacity of 100 pages of 8.5X11 inch paper. The contractor is responsible for maintaining a supply of printer paper and other consumables such as printer cartridges. Printer usage will not exceed 500 pages per month.

3.3.5 Satellite Data Modem

The contractor shall provide a satellite phone or modem, establish service and install the relevant equipment for use as a data link. The satellite data transmission device shall be equal to or equivalent to a SeaTel Wavecall 3000 or Qualcomm GSP-1620 which have the following salient characteristics: connection to externally mounted antenna, db-9 connector serial data transmission port, compatible with the Globlalstar satellite system, 9.6Kbaud data transmission rate, no internet service provider required to access the Internet, and compatible with Microsoft windows dialup networking. The data transmission time required is 1 to 3 minutes for each hopper load.
To avoid data interference, the satellite data modem is for the excusive use of the DMC computer during the length of the contract. The contractor shall provide copies of all relevant operating and reference manuals for the satellite data phone/modem. As in 3.3.1 if the modem fails then the contractor shall repair it within 48 hours.

3.3.6 Figure of Contractor provided equipment



3.4 DATA REPORTING INTERFACE

Standard data shall be sent to the CONTRACTING OFFICER or his/her representative's computer. The sensor data should be output via an RS-232 19200-baud serial interface to the CONTRACTING OFFICER or his/her representative's data-monitoring computer. The serial interface shall be configured as 8 bits no parity and no flow control.

3.4.1 Data Measurement Interval

Data are reported as a series of events. Disposal activities are required to be logged with high temporal and spatial resolution. A standard data string should be nominally sent every 10 seconds. The failure to send a data string within 25 seconds to the CONTRACTING OFFICER or his/her representative's computer results in a dredge down status determination by the automated monitoring system if the dredge is within two miles of the disposal or dredging area. Data strings should

never be sent more frequently than one per second. The standard events are in the following table:

Event Description	**Event Time Resolution**
An elapsed time of 10 seconds since the last event	1 second
Start of Disposal Activity	1 second
End of Disposal Activity	1 second

3.4.2 XML Reporting Data Format

The data are reported as an eXtensible Markup Language (W3C standard XML 1.0) document. The format required here facilitates viewing the data in a web browser as well as automated handling of the data. Data tags that are marked optional may be omitted or reported according the XML convention of <TAG_NAME/> to signify an empty tag. Line Breaks and spaces are added for readability here, but the carriage return, line feed character combination is only added to delineate records (HOPPER_DREDGING_DATA tag) for actual data transmission.

<?xml version="1.0"?>
<HOPPER_DREDGING_DATA version = “2.0”>
<DREDGE_NAME> **string32** </DREDGE_NAME>
<HOPPER_DATA_RECORD>
<DATE_TIME> **time date string** </DATE_TIME>
<LOAD_NUMBER> **integer string** </LOAD_NUMBER>
<VESSEL_X coord_type = “(SP,LL,UTM)”> **floating point string** </VESSEL_X>
<VESSEL_Y coord_type = “(SP,LL,UTM)”> **floating point string** </VESSEL_Y>
<DRAFT_FORE> **floating point string** </DRAFT_FORE>
<DRAFT_AFT> **floating point string** </DRAFT_AFT>
<VESSEL_SPEED> **floating point string** </VESSEL_SPEED>
<VESSEL_HEADING> **floating point string** </VESSEL_HEADING>
<VESSEL_COURSE> **floating point string** </VESSEL_COURSE >
<DRAGHEAD_DEPTH_PORT> **floating point string** </DRAGHEAD_DEPTH_PORT>
<DRAGHEAD_DEPTH_STBD> **floating point string** </DRAGHEAD_DEPTH_STBD>
<ULLAGE_FORE> **floating point string** </ULLAGE_FORE>
<ULLAGE_AFT> **floating point string** </ULLAGE_AFT>
<HOPPER_VOLUME> **floating point string** </HOPPER_VOLUME>

<DISPLACEMENT> **floating point string** </DISPLACEMENT>
(Optional) <EMPTY_DISPLACEMENT> **floating point string** </EMPTY_DISPLACEMENT>
<TIDE> **floating point string** </TIDE>
<HULL_STATUS> **OPEN/CLOSED string** </HULL_STATUS>
<PUMP_WATER_PORT> **true/false/unknown string** </PUMP_WATER_PORT>
<PUMP_WATER_STBD> **true/false/unknown string** </PUMP_WATER_STBD>
<PUMP_MATERIAL_PORT> **true/false/unknown string**</PUMP_MATERIAL_PORT>
<PUMP_MATERIAL_STBD> **true/false/unknown string** </PUMP_MATERIAL_STBD>
<PUMP_OUT_ON> **true/false/unknown string** </PUMP_OUT_ON>
<MIN_PUMP_EFFORT_PORT> **true/false/unknown string** </MIN_PUMP_EFFORT_PORT>
<MIN_PUMP_EFFORT_STBD> **true/false/unknown string** </MIN_PUMP_EFFORT_STBD>
<PORT_VELOCITY> **floating point string** </PORT_VELOCITY>
<PORT_DENSITY> **floating point string** </PORT_DENSITY>
<STBD_VELOCITY> **floating point string** </STBD_VELOCITY>
<STBD_DENSITY> **floating point string** </STBD_DENSITY>

The following tags are optional unless otherwise stated in section 3.4.3.

<PORT_DRAG_X coord_type = "(SP,LL,UTM)"> **floating point string**</PORT_DRAG_X>
<PORT_DRAG_Y coord_type = "(SP,LL,UTM)"> **floating point string**</PORT_DRAG_Y>
<STBD_DRAG_X coord_type = "(SP,LL,UTM)"> **floating point string**</STBD_DRAG_X>
<STBD_DRAG_Y coord_type = "(SP,LL,UTM)"> **floating point string**</STBD_DRAG_Y>
<WATER_DEPTH> **floating point string** </WATER_DEPTH>
<PUMP_RPM_PORT> **floating point string** </PUMP_RPM_PORT>
<PUMP_RPM_STBD> **floating point string** </PUMP_RPM_STBD>
<STBD_GIMBAL_DEPTH> **floating point string** </STBD_GIMBAL_DEPTH>
<PORT_GIMBAL_DEPTH> **floating point string** </PORT_GIMBAL_DEPTH>

The end of optional tags

</HOPPER_DATA_RECORD>
</HOPPER_DREDGING_DATA>
Carriage return – ASCII value 13
Line Feed – ASCII value 10

3.4.3 Reporting Data Metadata

Data Tag	Tag Notes
LOAD_NUMBER	The number of the load the dredge is currently working on. Normally, the load number is incremented at the completion of the disposal phase of each loading cycle. Loads are determined

Data Tag	Tag Notes
	according to the convention specified by the CONTRACTING OFFICER or his/her representative.
X_POSITION	Dredge X position. Latitude or Easting in state plane coordinates. West Longitude values are reported as negative and Northerly Latitude reported as positive. Latitude and Longitude values are to be reported to the hundredth of a minute. State plane coordinates may be reported to the nearest whole foot and are the preferred means of position reporting. The attribute **coord_type** has the value SP for state plane coordinates, LL for Latitude or Longitude and UTM for Universal Transverse Mercator coordinates. Only these three values are valid.
Y_POSITION	Dredge Y position. Longitude or Northing in state plane coordinates. The same comments for the X_POSITION tag apply.
STBD_DRAG_X PORT_DRAG_X	Draghead X position as computed or measured by the contractor. The same comments for the X_POSITION tag apply. The coord type attribute should have the same value for this tag as for the X_POSITION and Y_POSITION tags.
PORT_DRAG_Y STBD_DRAG_Y	Draghead Y position. The coord type attribute should have the same value for this tag as for the X_POSITION and Y_POSITION tags. The same comments for the X_POSITION tag apply.
DATE_TIME	mm/dd/yyyy hh:mm:ss defined as UTC time of the measurement. All of the measurements should have occurred within one second of this reported time.
DRAGHEAD_DEPTH_PORT DRAGHEAD_DEPTH_STBD	Depth below water surface of the low fixed point of each draghead. This value includes a correction for the draft and trim of the vessel, and is not depth below the keel.
HULL_STATUS	OPEN or CLOSED are the only permissible values. If the hull is split, then the value is OPEN. If the hull is closed, then the value is CLOSED. Status of the hopper doors as either open (OPEN), all doors fully closed (CLOSED). Any single hopper door open requires a door open status.

Data Tag	Tag Notes
MIN_PUMP_EFFORT_PORT MIN_PUMP_EFFORT_STBD	True when the hopper dredge's dredge pumps are either idling to assure minimum dragarm intake velocity or off. Pump revolutions per minute below a certain idle threshold or dragarm slurry velocity at or below the idle speed threshold could be used depending on the particular dredge plant and project. The criteria may be tailored for each dredge and project. Reported as true or false.
PUMP_MATERIAL_PORT PUMP_MATERIAL_STBD	True when the hopper dredge is digging material. For example when the slurry velocity is greater than 10 feet per second and the density is greater than 1.05 grams per cubic centimeter, then material recovery is true. These criteria may be tailored for each dredge and project. This value is applied to each dragarm. Reported as true or false.
PUMP_WATER_PORT PUMP_WATER_STBD	True when the hopper dredge is not recovering material but only pumping water. For example when the slurry density is less than 1.05 grams per cubic centimeter, then the dredge is pumping water. This criterion may be tailored for each dredge and project. Other parameters such as pump vacuum (for example) could be used to satisfy the pumping water requirement. Reported as true or false.
PUMP_OUT_ON	Status of pumpout activity. When pumpout is active the value is true, when pumpout is not active the value is false.
VESSEL_SPEED	The vessel speed measured in knots at the reported time.
VESSEL_HEADING	The dredge heading reported from 0 to 359 degrees
VESSEL_COURSE	The dredge course over ground reported from 0 to 359 degrees
DRAFT_FORE DRAFT_AFT	Draft of vessel in feet at the forward and aft sensor locations
DISPLACEMENT	Weight of the dredge at the time of measurement in long tons.
PUMP_RPM_PORT PUMP_RPM_STBD	The shaft revolutions per minute of the pumps that are used to pump excavated slurry. Dredges that have multiple pumps per side should select the pump that best describes the dredging process and document this in the DPIP (typically the outboard pumps). Pump RPM that are used to compute the PUMP_WATER,

Data Tag	Tag Notes
	PUMP_MATERIAL and MIN_PUMP_EFFORT tags should be included here. This parameter (is/is not) required for this contract.
EMPTY_DISPLACEMENT	Weight of the dredge with a completely empty hopper in long tons for the current load. This parameter (is/is not) required for this contract.
ULLAGE_FORE ULLAGE_AFT	Distance from the top of the bin down to the surface of the dredged material in the bin (measured in feet). This distance is called ullage and the corresponding capacity tables are known as hopper ullage tables. These values are obtained either by averaging multiple sensors (i.e., from port and starboard corners of the fore bin for one value and, from port and starboard corners of the aft bin for another) or optimal placement of a single fore and single aft sensor.
PORT_SLURRY_DENSITY STBD_SLURRY_DENSITY	Instantaneous dragarm slurry density (grams/cubic centimeters)
PORT_SLURRY_VELOCITY STBD_SLURRY_VELOCITY	Instantaneous dragarm slurry velocity (feet/second)
WATER DEPTH	Depth below the keel at the location of the sensor. This parameter (is/is not) required for this contract.
PORT_GIMBAL_DEPTH STBD_GIMBAL_DEPTH	Depth below water surface of the dragarm gimbals. This parameter (is/is not) required for this contract.
HOPPER_VOLUME	Volume of the bin in cubic yards computed from the ullage sensor values.

3.4.4 Data Reporting Example

```
<?xml version="1.0"?>
<HOPPER_DREDGING_DATA version = “2.0”>
  <DREDGE_NAME>Essayons</DREDGE_NAME>
    <HOPPER_DATA_RECORD>
        <DATE_TIME>04/11/2002 13:12:05</DATE_TIME>
        <LOAD_NUMBER>102</LOAD_NUMBER>
        <VESSEL_X coord_type =  "LL">10.123345</VESSEL_X>
        <VESSEL_Y coord_type =  "LL">-80.123333</VESSEL_Y>
        <DRAFT_FORE>10.05</DRAFT_FORE>
        <DRAFT_AFT>15.13</DRAFT_AFT>
        <VESSEL_SPEED>3.4</VESSEL_SPEED>
        <VESSEL_HEADING>302</VESSEL_HEADING>
        <VESSEL_COURSE>258</VESSEL_COURSE>
        <DRAGHEAD_DEPTH_PORT>55.10</DRAGHEAD_DEPTH_PORT>
        <DRAGHEAD_DEPTH_STBD>53.21</DRAGHEAD_DEPTH_STBD>
        <ULLAGE_FORE>10.11</ULLAGE_FORE>
        <ULLAGE_AFT>10.22</ULLAGE_AFT>
        <HOPPER_VOLUME>2555.2</HOPPER_VOLUME>
        <DISPLACEMENT>4444.1</DISPLACEMENT>
        <EMPTY_DISPLACEMENT>2345.0</EMPTY_DISPLACEMENT>
        <TIDE>-0.1</TIDE>
        <HULL_STATUS>CLOSED</HULL_STATUS>
        <PUMP_WATER_PORT>true</PUMP_WATER_PORT>
        <PUMP_WATER_STBD>true</PUMP_WATER_STBD>
        <PUMP_MATERIAL_PORT>false</PUMP_MATERIAL_PORT>
        <PUMP_MATERIAL_STBD>false</PUMP_MATERIAL_STBD>
        <PUMP_OUT_ON>false</PUMP_OUT_ON>
        <MIN_PUMP_EFFORT_PORT>false</MIN_PUMP_EFFORT_PORT>
        <MIN_PUMP_EFFORT_STBD>false</MIN_PUMP_EFFORT_STBD>
        <PORT_VELOCITY>22.1</PORT_VELOCITY>
         <PORT_DENSITY>1.02</PORT_DENSITY>
       <STBD_VELOCITY>23.3</STBD_VELOCITY>
        <STBD_DENSITY>1.03</STBD_DENSITY>
       <WATER_DEPTH/>
        <PORT_DRAG_X coord_type =  "LL">10.123351</PORT_DRAG_X >
        <PORT_DRAG_Y coord_type =  "LL">-80.123337</PORT_DRAG_Y >
        <STBD_DRAG_X coord_type =  "LL">10.123347</STBD_DRAG_X >
        <STBD_DRAG_Y coord_type =  "LL">-80.123339</STBD_DRAG_Y >
```

</HOPPER_DATA_RECORD>
</HOPPER_DREDGING_DATA>
<cr>
<lf>

3.4.5 Legacy Data Reporting Format

For compatibility, the previous version (Legacy) of the hopper dredge data transfer standard is included. Existing implementations of this standard may be used if the contracting officer requires only the reporting of parameters that are part of legacy reporting. Reporting parameters not contained in the legacy format (such as empty displacement or drag head position) shall be reported via XML tags as described in 3.4.1. This legacy standard may be depreciated at a future date so all new implementations shall use the XML tags (3.4.1).

Sensor Data (Parameter)	**Units**	**Data Format**	**Character Length**	**Character Position**
Version	V1.11	ASCII string	5	1 - 5
Date	yymmdd (local)	ASCII string	6	6-11
Time	hhmmss (local)	ASCII string	6	12-17
Position Error	feet	Floating point	4	18-21
X location	feet	Floating point	7	22-28
Y location	feet	Floating point	7	29-35
Forward draft	feet	Floating point	6	36-41
Aft draft	feet	Floating point	6	42-47
Tide elevation	feet	Floating point	5	48-52
Port dragarm velocity	feet/sec	Floating point	4	53-56
Port dragarm density	grams/liter	Floating point	4	57-60
Starboard dragarm velocity	feet/sec	Floating point	4	61-64
Starboard dragarm density	grams/liter	Floating point	4	65-68
Port gimbal depth	feet	Floating point	4	69-72
Starboard gimbal depth	feet	Floating point	4	73-76
Port draghead depth	feet	Floating point	4	77-80
Starboard draghead depth	feet	Floating point	4	81-84
Heading	degrees true	Integer	3	85-87
Course	degrees true	Integer	3	88-90
Water depth (below hull)	feet	Floating point	4	91-94
Speed (over ground)	knots	Floating point	4	95-98
Hopper volume	cubic yards	Floating point	6	99-104
Current ship weight	long tons	Floating point	6	105-110
Forward ullage	feet	Floating point	4	111-114
Aft ullage	feet	Floating point	4	115-118
Stb. minimum pumping effort	T/F	ASCII	1	119
Port minimum pumping effort	T/F	ASCII	1	120
Starboard pumping water	T/F	ASCII	1	121
Port pumping water	T/F	ASCII	1	122
Port material recovery	T/F	ASCII	1	123
Starboard material recovery	T/F	ASCII	1	124
Hopper open	T/F	ASCII	1	125
Pumpout Active	T/F	ASCII	1	126
Load Number	loads	Integer	4	127-130
<Carriage Return>	n/a	ASCII	1	131
<Line Feed>	n/a	ASCII	1	132

Example data string:

V1.11991208015929 1.1798859 96072 6.8 8.3 1.4 .0 .00<line break>
.01.02 .0 3.3 .0 4.9 7 8 7.610.0 747. 521. 3.8 4.6FFFFFFFF0111<cr><lf>

3.4.6 Legacy Format Data Reporting Metadata

Any data that are out of range, missing, or considered unusable for any other reason shall be reported as the value 999. If a true/false value cannot be computed, then it should be reported as the letter U for unknown. Each data string is followed by a carriage return - line feed combination. The definitions of the data parameters follow:

Version Version of string - This version is designated V1.11

Date Date in local time of the sensor measurements, formatted yymmdd.

Time Local time of the measurements formatted hhmmss.

Position Error
For conventional positioning systems this is the RMS error of ship's position based on the X and Y range values used to calculate the position. For a GPS-based system, this is the Horizontal Dilution of Precision (HDOP) value.

X location X (easting) position of the dredge.

Y location Y (northing) position of the dredge.

Forward and aft draft
Draft of vessel below waterline at the forward and aft sensor locations.

Tide elevation Tide height relative to district standard datums.

Port & Stbd dragarm velocity Velocity of water moving through the dragarms.

Port & Stbd dragarm density
Specific gravity of water/material mixture in the dragarms. Valid values are 1.0 to 2.0; values < 1.0 indicate no water in the dragarm.

Port & Stbd. gimbal depth Depth below water surface of the dragarm gimbals. *Optional***.**

Port & Stbd. draghead depth

Depth below water surface of the low fixed point of each draghead. This value includes a correction for the draft and trim of the vessel, and is not depth below the keel.

Heading Heading in degrees of the vessel. Values are from 000 to 359.

Course
Vessel course in degrees made good as computed from the vessel's navigation system data over 10 second intervals. Values are from 000 to 359.

Water depth Depth below the keel at the location of the sensor. *Optional.*

Speed Vessel speed over the ground averaged over the reporting interval.

Current ship weight Weight of the vessel at the time of measurement.

Ullage (fore, aft)
Distance from the top of the hopper down to the surface of the dredged material in the hopper. This distance is called ullage and the corresponding capacity tables are known as hopper ullage tables. These values are obtained either by averaging multiple sensors (i.e., from port and starboard corners of the fore hopper for one value and, from port and starboard corners of the aft hopper for another) or optimal placement of a single fore and single aft sensor.

Hull - Split or closed
If the hull is split, then the value is true. If the hull is closed, then the value is false.

Hopper doors - open or closed
Status of the hopper doors as either open (true), all doors fully closed (false), or undetermined (unknown). Any single hopper door open requires a door open status.

Pumpout
Status of pumpout activity. When pumpout is active the value is true, when pumpout is not active the value is false.

Material Recovery
True when the hopper dredge is digging material. For example when the slurry velocity is greater than 10 feet per second and the density is greater than 1.05 grams per cubic centimeter, then material recovery is True. These criteria may be tailored for each dredge and project. This value is applied to each dragarm.

Pumping Water

True when the hopper dredge is not recovering material but only pumping water. For example when the slurry density is less than 1.05 grams per cubic centimeter, then the dredge is pumping water. This criterion may be tailored for each dredge and project. Other parameters such as pump vacuum (for example) could be used to satisfy the pumping water requirement.

Minimum Pumping Effort
True when the hopper dredge's dredge pumps are either idling to assure minimum dragarm intake velocity or off. Pump revolutions per minute below a certain idle threshold or dragarm slurry velocity at or below the idle speed threshold could be used depending on the particular dredge plant and project. The minimum pumping effort value is reported for each dragarm. The criteria may be tailored for each dredge and project.

Load Number
The number of the load that the dredge is currently working on. Typically the load number is incremented at the completion of the disposal phase of each loading cycle. Loads are determined according to the convention specified by the CONTRACTING OFFICER or his/her representative.

3.4.7 Contractor Data Backup

The dredging contractor shall maintain an archive of the data sent to the CONTRACTING OFFICER or his/her representative's computer for the length of the dredging project. The CONTRACTING OFFICER or his/her representative may request (at no additional cost to the contract price) that the contractor provide a copy of these data covering specified time periods. The data shall be provided on PC format CD-ROM (or other storage medium acceptable to the CONTRACTING OFFICER or his/her representative) and each of the requested time periods shall be identified.

3.5 DREDGE PLANT INSTRUMENTATION PLAN

The contractor shall submit a Dredge Plant Instrumentation Plan (DPIP) prior to commencement of dredging operations and shall maintain a separate copy of the DPIP onboard the dredge. Refer to section 3.8 for the schedule of submittal. The plan shall include at a minimum:

3.5.1 Dredge Computations and Documentation

All computations for a particular dredge concerning deriving computed data elements as required in section 3.4.3 from sensor data elements shall be provided

to the CONTRACTING OFFICER or his/her representative. Any changes to the computing methods during the dredging contract must be approved in writing by the CONTRACTING OFFICER or his/her representative prior to the change being applied. These computations include the vessel displacement, hopper volume, material recovery, pumping water, and the minimum pumping effort.

The contractor shall provide the dragpipe length dimensions and offset distances from the DGPS antenna location to the centerline of each draghead. The inside pipe diameter along with the location of the slurry density and slurry velocity metering system sensors shall also be provided to the CONTRACTING OFFICER or his/her representative. All dimensions and drawings are to be certified by a licensed marine surveyor or architect.

The contractor shall also provide the CONTRACTING OFFICER or his/her representative with dimensioned-drawings of the hopper with hopper level sensor locations included. These drawings should include hopper length, depth, and width with hopper level sensors referenced to the overall dimensions. A typical mid-ship hopper cross-section should be included with dimensions. The overall dredge dimensions shall also be provided, indicating the locations of the fore and aft draft sensors with regard to; 1) horizontal and vertical distances from the keel, 2) horizontal and vertical distances between each draft sensor, 3) vertical distances to the hopper level sensors, 4) distance of aft draft sensor to aft perpendicular, 5) distance of fore draft sensor to fore perpendicular, 6) distance of the aft draft sensor from the midship section, and 7) distance of the fore draft sensor from the midship section. The contractor shall also provide in writing as part of the DPIP; how to relate fore and aft ullage sensor measurements to hopper volume calculations.

3.5.2 Data Reporting

Non-standard sensor data names not in section 3.4.3 shall be supplied to the CONTRACTING OFFICER or his/her representative. An example ASCII format file of data to be exported to the CONTRACTING OFFICER or his/her representative's computer shall be provided with the DPIP.

3.5.3 Computer Hardware

The brand name and specifications of furnished computer hardware.

3.5.4 Calibrations

The contractor shall provide certificates of calibration and/or manufacturer certificates of compliance for all needed dredge information. These include slurry

density, slurry velocity, heading, draft, hopper level, water depth, and draghead depth.

3.5.5 Instrumentation Quality Control Methods

Test methods used by the contractor to provide quality control of input sensor data should be documented. These test methods shall include the checking of sensors to verify that reported values are applicable for that sensor and the particular project being dredged

3.5.6 Sensor Log

The contractor shall maintain a log of sensor performance and modifications during the length of the dredging contract. The log shall contain the time when a sensor fails (and subsequently repaired). The log shall also include the time and results of sensor calibrations, the time of sensor replacements, and the time when backup sensor systems are initiated to provide required data. It shall also contain the name of the person responsible for the sensor work. Only sensors that affect the data reported in section 3.4.3 are affected by this logging requirement.

3.5.7 Hopper Volume and Dredge Displacement

In the DPIP, the contractor shall supply the CONTRACTING OFFICER or his/her representative with the dredge ullage table which lists the hopper volume as a function of hopper level, a dredge draft displacement table listing the dredge displacement as a function of draft, and the vessel's hydrostatic curves and lines drawing. A licensed marine surveyor or architect who is independent of the contractor must certify these tables, curves, and lines drawing. The submitted ullage table will be reviewed and, upon approval, be certified by the visible Silent Inspector (SI) date stamp affixed to each page of the approved ullage table. The USACE will supply the contractor with a copy of the certified SI date stamp affixed ullage table. The SI certified ullage table is to be contained within the copy of the DPIP submitted to the USACE and the copy of the DPIP stored on-board the dredge (see section 3.5). The contractor should specify the most accurate method for calculating hopper volume based on fore and aft hopper level and displacement based on fore and aft draft.

3.5.8 Summary of DPIP Deliverables

Description	Referring Section
Hopper volume computation, hopper ullage table	3.5.1, 3.5.7
Dredge displacement computation	3.5.1, 3.5.7
Dredge dimensions - dragpipe lengths, offset distance from DGPS antenna, draft sensor/hull draft markings relation, draft and hopper sensor offsets	3.5.1, 3.1.6, 3.6.2
Hopper dimensioned drawing	3.5.1
Hopper cross-section drawing	3.5.1
Overall dredge dimensioned drawing	3.5.1
Vessel's hydrostatic curves and lines drawing	3.5.1
Quality control methods	3.5.5
Computer system hardware documentation	3.5.3, 3.3.1, 3.3.2, 3.3.3, 3.3.4
Proposed revisions to data reporting interface	3.5.2, 3.4.1, 3.4.2
Sensor calibrations - draft, slurry density, slurry velocity, hopper level, water depth, and draghead depth	3.5.4, 3.1.1, 3.1.2, 3.1.3, 3.1.6, 3.1.7, 3.1.10
Sensor Log	3.5.6, 3.4.1, 3.4.2

3.6 QUALITY ASSURANCE TESTS

3.6.1 Water Test

Each water test shall consist of pumping the hopper out to its lowest level and then filling the hopper to capacity with water. The objective of the water test is to assure data consistency by comparing the system-measured water specific gravity to that of the value determined by analyzing water samples retrieved from the hopper. The CONTRACTING OFFICER or his/her representative will direct the contractor in performing up to three water tests at no additional cost to the contract price. After the first water test, the CONTRACTING OFFICER or his/her representative will evaluate the data for accuracy. If the CONTRACTING OFFICER or his/her representative's review of the data indicates an unsatisfactory calibration, a re-calibration of the sensors and review of contractor-supplied displacement and hopper volume may be necessary before completing additional water tests. During dredging operations, up to two additional water tests may be conducted per week at the time and discretion of the CONTRACTING OFFICER or his/her representative. The CONTRACTING OFFICER or his/her representative will review the water test data to insure that the system is operating within acceptable accuracy, directing the contractor to re-calibrate or repair system components as necessary.

The Contractor shall provide a handheld refractometer with automatic temperature compensation to measure the hopper water specific gravity during water tests. The refractometer shall be capable of measuring the hopper water's specific gravity with a resolution of 0.001 and minimum accuracy of $\pm$ 0.001. The Contractor shall also provide a water-sampling device to retrieve a sufficient volume of water from various depths in the hopper to accurately determine specific gravity with the refractometer.

3.6.2 Relative water level tests

The relative water level test consists of opening the bottom dump doors (or corresponding equipment) to allow the water level surrounding the dredge to equalize with the water level in the hopper and comparing the draft and ullage sensor-measured values of the same water plane. During dredging operations, up to two additional relative water level tests may be conducted per week at the time and discretion of the CONTRACTING OFFICER or his/her representative. The CONTRACTING OFFICER or his/her representative will review the test data to insure that the system is operating within acceptable accuracy, directing the contractor to re-calibrate or repair system components as necessary. The contractor shall provide to the CONTRACTING OFFICER or his/her representative sufficient dredge configuration data including the vertical distance between hopper level sensors and draft sensors.

3.6.3 Hopper level

The CONTRACTING OFFICER or his/her representative will periodically check the reported hopper level. Tape measure or other distance measuring means shall be used. The Contractor shall have on the dredge a clearly readable weighted tape with measurements shown in foot-and-tenths-and hundredths, capable of measuring the full hopper depth. The weight for this tape shall be a 6-inch diameter disk weighing between 2 and 3 pounds. The CONTRACTING OFFICER or his/her representative will review the hopper level data to insure that the system is operating within acceptable accuracy (1/10 foot), directing the contractor to re-calibrate or repair system components as necessary.

3.6.4 Draghead Depth

The CONTRACTING OFFICER or his/her representative may require periodic calibration checks of the reported draghead depth over a calibration point at the project site. The CONTRACTING OFFICER or his/her representative may also use direct means such as tape measures, sounding lines, and pressure sensors to directly measure draghead depth. The Contractor shall have on the dredge a clearly readable steel tape, chain, or wire graduated in 1 and 1/2 foot increments. This tape or chain shall be capable of measuring the depth below water surface of the low fixed point of each draghead with sufficient length to measure 5 feet over the maximum project depth. . The CONTRACTING OFFICER or his/her representative will review the hopper level data to insure that the system is operating within acceptable accuracy, directing the contractor to re-calibrate or repair system components as necessary.

3.7 LIST OF ITEMS PROVIDED BY THE CONTRACTOR

Description	Section Reference
Computer system, UPS, and printer	3.3.1, 3.3.3, 3.3.4
Network hub	3.3.2
Dredge Plant Instrumentation Plan	1.3, 3.1, 3.5, 3.5.3, 3.5.4, 3.5.5, 3.5.6
Dredge hopper level and volume	3.1.7, 3.5.7, 3.6.3, 3.6.1, 3.6.2, 3.6.3
Dredge draft and displacement	3.5.1, 3.1.6, 3.2, 3.5.7, 3.6.1, 3.6.2
Data reporting interface	3.4, 3.4.1, 3.4.2, 3.4.3, 3.2, 3.3.1
Dredge heading	3.1.5, 3.2, 3.4.1, 3.4.2
Draghead depths	3.1.3, 3.6.4, 3.2
Report tide level	3.1.8, 3.4.3, 3.2
Hopper status	3.1.9, 3.4.2, 3.4.3, 3.2
Dredge material recovery status	3.1.10, 3.4.2, 3.4.3, 3.2
Dredge Data Acquisition Time	3.1.11, 3.4, 3.4.2, 3.4.3, 3.2
Slurry density	3.5.4, 3.4.2, 3.4.3, 3.2
Slurry velocity	3.5.4, 3.4.2, 3.4.3, 3.2
Pumpout status	3.1.12, 3.4.2, 3.4.3, 3.2
Dredge pumping water status	3.1.13, 3.4.2, 3.4.3, 3.2
Dredge minimum pumping effort status	3.1.14, 3.4.2, 3.4.3, 3.2
Dredge position	3.4.2, 3.4.3, 3.1.4, 3.2
Refractometer	3.6.1
Water Sampling Device	3.6.1
Hopper level measurement tape	3.6.3
Draghead depth measurement tape	3.6.4

3.8 SCHEDULE OF DPIP SUBMITTAL (TAILORED BY DISTRICT)

The Contractor DPIP submittal shall be required by the Notice to Proceed date. Within 7 days after receipt of the DPIP, the CONTRACTING OFFICER or his/her representative will review and comment on its acceptability. After this DPIP is reviewed and accepted by the CONTRACTING OFFICER or his/her representative, the onboard system will be required to be inspected, approved by the CONTRACTING OFFICER or his/her representative, and operational within 15 days of the Notice to Proceed.

(District Optional)
If the system is not operational after 15 days after the Notice to Proceed, or if the system becomes inoperable for a period of time greater than allowed in the specification, the Dredging unit price, for each assignment, will each be reduced to 80% of the original bid price for the hours when the system is not fully operational.